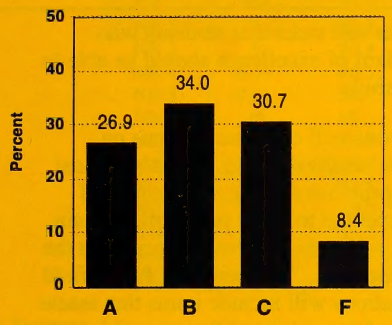
AL. 1.1131
c-2
CANADIANA
JUN 18 1995

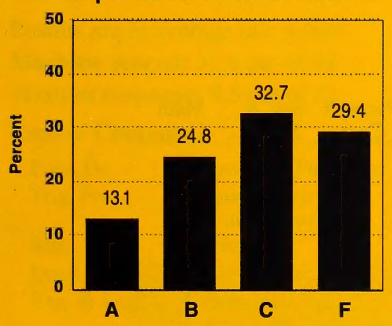
Mathematics 30

Diploma Examination Results
Examiners' Report for January 1995

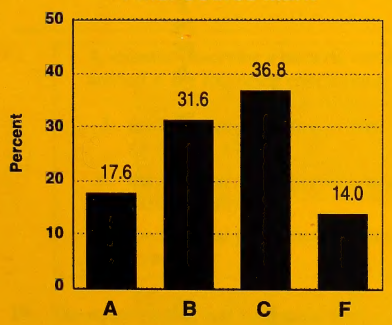
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1995 administration of the Mathematics 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Mathematics 30 Diploma Examination consists of three parts: a multiple-choice section of 40 questions worth 57%, a numerical-response section of nine questions worth 13%, and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 10 420 students who wrote the January 1995 examination.

- 86.0% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 17.6% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50% of the students who wrote the January 1995 examination were females.

- 85.8% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 16.2% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50% of the students who wrote the January 1995 examination were males.

- 86.2% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 19.0% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Students First!
Student Evaluation

Alberta
EDUCATION

Provincial Averages

- The average school-awarded mark was 68.7%.
- The average diploma examination mark was 59.3%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 64.3%.

Of the 10 420 students who wrote the January 1995 examination, 1 751 had written at least one Math 30 exam previously. Their performance on the January 1995 examination increased to a mean of 60.0% from a mean of 50.2% on previous examinations.

Results and Examiners' Comments

This examination has a balance of question types and difficulties reflecting the philosophy of the Mathematics 30 Course of Studies. It was designed so that students who are achieving the acceptable standard in Math 30 should obtain a mark of 50% or higher. Students who are achieving the standard of excellence in Mathematics 30 should obtain a mark of 80% or higher. The student who is achieving the acceptable standard or the standard of excellence is expected to be able to achieve the curriculum standards identified in Mathematics 30 Information Bulletin. At least 70% of the examination includes questions and tasks that students who achieve the acceptable standard should be able to complete successfully. The remaining part of the examination includes questions and tasks that students who achieve the standard of excellence should be able to complete successfully.

Future examinations will continue to focus on assessing students' understanding of mathematical concepts and on problem solving. Students will continue to be expected to solve problems, explain solutions, justify solutions, or prove solutions in the written-response section. The design of future field tests and examinations will include items that assess how well students have achieved the general learner expectations stated in the Mathematics 30 Course of Studies.

Blueprint

Question	Key	Difficulty	Poly. Fn.	Trig. Fn.	Stat.	Quad. Rltns.	Exp. & Log.	Perm. & Com.	Seq. & Series	Math Und.
MC 1	C	87.3	√							P
MC 2	D	72.3	√							C
MC 3	C	55.8	√							PS
MC 4	A	74.1	√							P
MC 5	A	35.9	√							C
MC 6	A	66.5	√							C
MC 7	C	93.2		√						C
MC 8	B	45.8		√						C
MC 9	B	63.3		√						P
MC 10	A	39.2		√						P
MC 11	C	87.0		√						C
MC 12	C	52.5		√						P
MC 13	D	71.2		√						PS
MC 14	B	36.8		√						PS
MC 15	D	85.3					√			P
MC 16	A	80.1					√			P
MC 17	A	77.5					√			PS
MC 18	D	65.1					√			P
MC 19	C	82.2					√			PS
MC 20	D	40.6					√			P
MC 21	A	52.8					√			P
MC 22	D	39.4					√			PS
MC 23	A	83.2							√	PS
MC 24	C	72.8							√	PS
MC 25	A	60.7							√	PS
MC 26	B	57.2							√	C
MC 27	D	84.2				√				C
MC 28	B	77.8				√				P
MC 29	A	62.7				√				C
MC 30	C	80.0				√				C
MC 31	D	51.6				√				P
MC 32	D	69.4				√				C

Question	Key	Difficulty	Poly. Fn.	Trig. Fn.	Stat.	Quad. Rltns.	Exp. & Log.	Perm. & Com.	Seq. & Series	Math Und.
MC 33	D	66.1				√				PS
MC 34	B	51.1				√				C
MC 35	B	72.0						√		PS
MC 36	B	56.7						√		PS
MC 37	C	64.2						√		P
MC 38	B	80.2			√					PS
MC 39	A	60.6			√					PS
MC 40	C	36.4			√					PS
NR 1	504	87.9						√		P
NR 2	2	80.4		√						C
NR 3	5	80.4						√		C
NR 4	6.33	86.5					√			P
NR 5	0.21	50.7					√			P
NR 6	46	65.3			√					P
NR 7	1.2	65.3			√					C
NR 8	0.71	33.4				√				PS
NR 9	4.0	23.5				√				PS
WR 1	—	40.0		√						PCPS
WR 2	—	55.7							√	PCPS
WR 3	—	48.0						√		PCPS
WR 4	—	38.0	√							PCPS

Subtest

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine scored: 31.6 out of 49

Written response: 9.8 out of 21

Course Content

Poly. Fn.	Polynomial Functions	5.8	out of	11
Trig. Fn.	Trigonometric and Circular Functions	7.3	out of	13
Stat.	Statistics	3.1	out of	5
Quad. Rltns.	Quadratic Relations	6.0	out of	10
Exp. & Log.	Exponential and Logarithmic Functions	6.6	out of	10
Perm. & Com.	Permutations and Combinations	6.0	out of	10
Seq. & Series	Sequences and Series	6.6	out of	11

Mathematical Understandings*

- Procedural (P): 11.2 out of 17
- Conceptual (C): 10.3 out of 15
- Problem Solving (PS): 10.1 out of 17

*Refer to Appendix D of the 1994–95 *Mathematics 30 Information Bulletin, Diploma Examinations Program,* for an explanation of mathematical understandings. These are the mathematical abilities described in Appendix D.

A scientist observing a bacteria culture arrived at the following conclusions:

I. the bacterial population at time $t = 0$ was 100

II. the bacterial population increases exponentially

III. the bacterial population doubles every hour

19. The equation that best represents the bacterial population growth $P(t)$ after t hours is

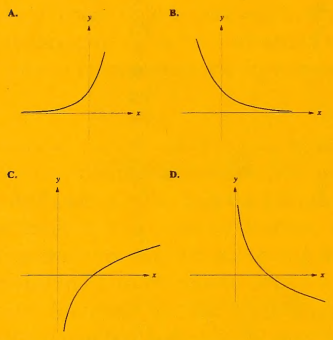
A. $P(t) = 200^t$
B. $P(t) = 200^{2t}$
•C. $P(t) = 100(2^t)$
D. $P(t) = 2(100)^t$

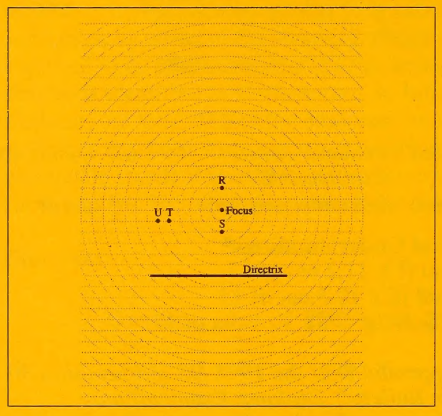
Multiple-Choice and Numerical-Response Questions

The multiple-choice and numerical-response sections of the examination ask a sample of questions that cover all content areas in Mathematics 30. A discussion about how well students achieve the curriculum standards in the units Exponential and Logarithmic Functions and Quadratic Relations follows.

Exponential and Logarithmic Functions—In order to achieve the curriculum standards for this unit, students should describe orally and in writing that the inverse of the exponential function is the logarithmic function, and then use this information in the solution of exponential equations. Students should also solve exponential equations, recognize the graphs of exponential and logarithmic functions, express an exponential expression in logarithmic form and vice versa, apply the laws and properties of logarithms to evaluate logarithmic expressions, and solve and verify simple exponential and logarithmic equations. Multiple-choice questions 15 to 22 and

22. The graph of $y = \log_{\frac{1}{3}} x$ is best represented by

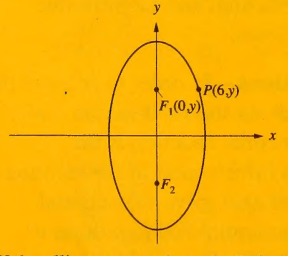




31. Which of the points, R, S, T, or U, will lie on a hyperbola with the given focus and directrix?

A. R
•B. S
C. T
D. U

9. The centre of the ellipse shown below is at the origin. One of its foci F_1 has coordinates $(0, y)$. The constant sum for this ellipse is 16.



If the ellipse passes through $P(6, y)$, then the value of y correct to the nearest tenth is 4.0 .
(Record your answer on the answer sheet.)

numerical-response questions 4 and 5 asked students to demonstrate their understanding of this unit. About 80% of the students who achieved the acceptable standard but not the standard of excellence were able to achieve the expectations of multiple-choice questions 15, 16, 17, and 18 and numerical-response question 4. About 50% of these students were able to achieve the expectations on multiple-choice question 21, whereas only about 36% of these students achieved the expectations on multiple-choice questions 20 and 22.

In addition, students who achieve the standard of excellence are expected to be able to solve and verify all exponential and logarithmic equations. Multiple-choice question 18 and numerical-response question 5 asked students to show that they can do this; 91% of the students who achieved the standard of excellence on the examination were able to demonstrate this on multiple-choice question 18, and 88% were able to demonstrate this on numerical-response question 5. Multiple-choice questions 20 and 22 identified expectations for those students who achieved the acceptable standard but not the standard of excellence; only about 70% of the students who achieved the standard of excellence on this examination were able to successfully achieve the expectations in these two questions.

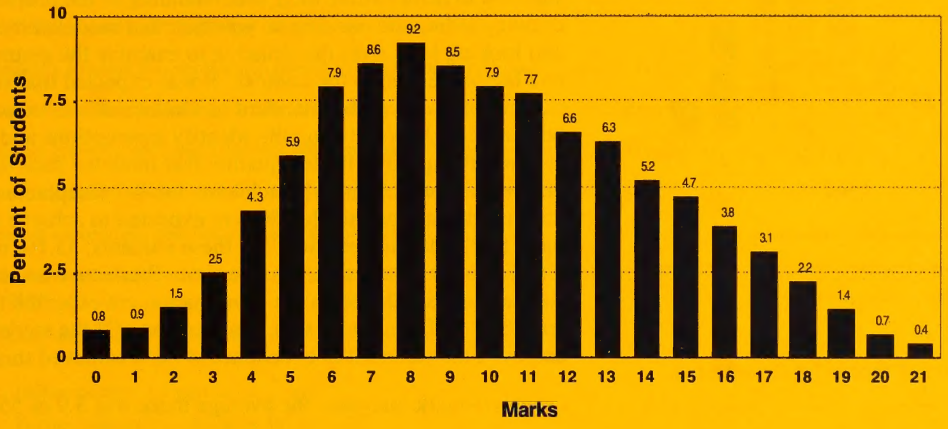
Quadratic Relations—To achieve the acceptable standard in quadratic relations, students must be able to describe orally, in writing, and by modeling, the intersection of a plane and a conical surface that would result in a hyperbola, an ellipse, a parabola, and a circle; describe, orally and in writing, and identify the quadratic relations defined by a combination of numerical coefficients for any quadratic relation in the form $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$, where $B = 0$; describe, orally and in writing, and identify the eccentricity when given the quadratic relation; describe, orally and in writing, and identify the quadratic relation formed when given the locus definition; and describe, orally and in writing, and identify the effects on the graph of the quadratic relation in the form $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$, where $B = 0$, when two of the numerical coefficients change. Multiple-choice questions 27 to 34 and numerical-response questions 8 and 9 ask students to demonstrate their understanding of this unit. About 80% of the students who achieved the acceptable standard but not the standard of excellence were able to correctly answer multiple-choice questions 27, 28, and 30; about 65% achieved the expectations on multiple-choice questions 29, 32, and 33; about 49% achieved the expectations on multiple-choice questions 31 and 33; and only 28% achieved the expectations on numerical-response question 8.

In addition to the expectations for the acceptable standard, students who achieve the standard of excellence must be able to verify the equation of each conic section and complete the solution to problems that require the analysis of quadratic relations studied in Mathematics 30. Numerical-response question 9 asks this of students. Only about 54% of the students who achieved the standard of excellence correctly answered this question, while 19% of the students who achieved the acceptable standard, but not the standard of excellence, achieved this expection.

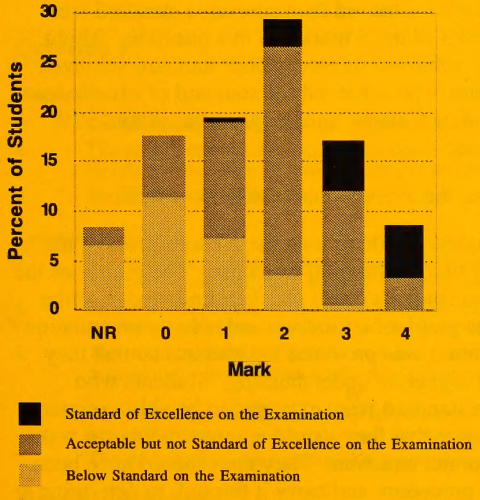
Written-Response Question

Questions in the written-response section dealt with four of the seven content strands for Mathematics 30. Students performing at the acceptable standard were expected to obtain at least half marks on all questions. Students performing at the standard of excellence were expected to answer all questions almost perfectly.

Distribution of Marks for Written Response



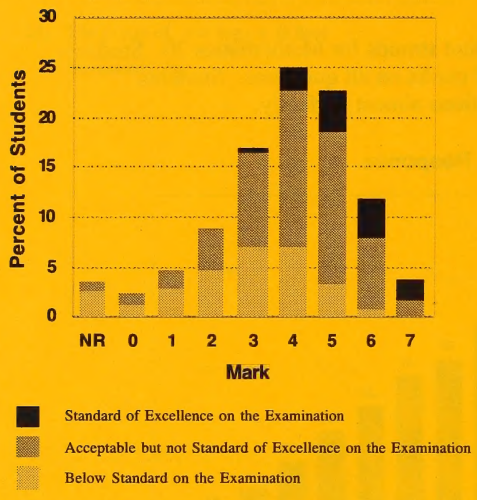
Distribution of Marks for Question 1



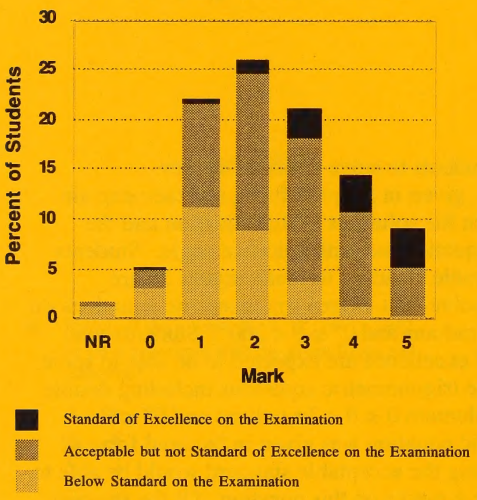
Question 1 required students to solve a second-degree trigonometric equation, given in factored form, and then explain the relationship between the solutions to that equation and the solutions to the same equation but with a double angle. Students who achieve the acceptable standard in Mathematics 30 are expected to be able to solve first-degree trigonometric equations on the domain $0 \leq \theta < 2\pi$ radians and $0° \leq \theta < 360°$. Students who achieve the standard of excellence are expected to be able to solve first- and second-degree trigonometric equations including double and half angles on the domain $0 \leq \theta < 2\pi$ radians and $0° \leq \theta < 360°$. The trigonometric equation was given in factored form so that all students achieving the acceptable standard would be able to achieve at least 2 of the 4 marks on this question. Of the students who achieved the acceptable standard, 62.3% received either 2, 3, or 4 marks on this question. The students who achieved the standard of excellence should have obtained 3 or 4 of 4 marks on this question. Of the students who achieved the standard of excellence, 72.4% achieved this.

On this 4-mark question, the average mark was 1.6 or 40%.

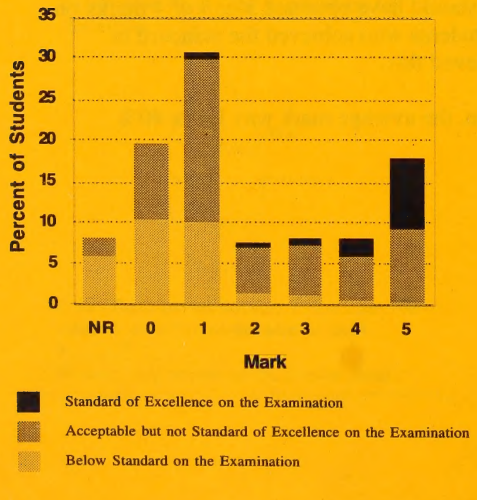
Distribution of Marks for Question 2



Distribution of Marks for Question 3



Distribution of Marks for Question 4



Question 2 All students who achieve the acceptable standard in Mathematics 30 are expected to participate in and contribute toward the problem-solving process for problems involving sum and term formulas for arithmetic and geometric series and sequences. The context for this question was the development of a telephone "fan-out" system and used the problem-solving expectations identified in the Mathematics 30 Course of Studies. This question required students to demonstrate their understanding of the problem by drawing a diagram, writing an equation that modeled their diagram, and looking back over the situation to examine the assumptions made and factors related to the context. It was expected that students who achieved the acceptable standard in Mathematics 30 should have been able to draw the diagram, identify assumptions and factors, and at least attempt to write an equation that modeled their diagram of the problem. The students who achieved the the acceptable standard but not the standard of excellence were expected to achieve at least 5 of the 7 marks on this question. Of these students, 33.1% received either 5, 6, or 7 marks on this question. Students who achieve the standard of excellence on the examination are expected to achieve at least 6 or 7 of the 7 marks on this question. Of the students who achieved the standard of excellence, 41.5% achieved this expectation.

On this 7-mark question, the average mark was 3.9 or 55.7%.

Question 3 required students to describe how a model that involved combinations and a model that involved permutations could be used to represent the same problem. Students who achieve the acceptable standard in Mathematics 30 are expected to be able to describe, orally and in writing, the difference between a permutation and a combination. Students who achieved the acceptable standard were expected to score at least 3 of the 5 marks on this question. About half of the students who achieved the acceptable standard achieved this expectation. Students who achieved the standard of excellence were expected to score 4 or 5 marks on this question. About 52% achieved this expectation.

On this 5-mark question, the average mark was 2.4 or 48%.

Question 4 required students to determine the x-coordinates of the points of intersection of two polynomial functions. The graphs of the functions were shown so students could use their knowledge of the relationship between the graph of a function and solving an equation. The first step in the solution was provided for students so that they could demonstrate their algebraic understanding. Students who achieved the acceptable standard were expected to be able to equate the two equations to realize that they would require finding the roots of a third-degree polynomial equation. They then should have been able to at least start the procedure and carry it through to determine at least one root. About 30% of the students who achieved the acceptable standard but not the standard of excellence achieved or exceeded this expectation. Students who achieved the standard of excellence were expected to complete the algebraic solution and arrive at all 3 exact values for the x-coordinates of the points of intersection. Of the students who achieved the standard of excellence, 57.8% achieved this expectation.

On this 5-mark question, the average mark was 1.9 or 38%.

Question 1

4 The student:
correctly solves the equation in part (a) giving the answer in **radian** measure
and
provides **2 correct relationships** between the solutions of the equations stated in part (b)
or
one relationship made with logical or causal connections made in part (b)

3 The student's solution is complete and correct in part (a) **or** part (b) **and** reaches a subgoal in the other part.

2 The student's solution for part (a) is complete and the answer is given in either **radian** or **degree** measure.
or
The student correctly provides **2 correct relationships** between the solutions of the equations stated in part (b).
or
The student provides one relationship made with logical or causal connections made in part (b).
or
The student successfully reaches a subgoal in both part (a) and part (b).

1 The student successfully reaches a subgoal in the solution for either part (a) or part (b) but is not successful in moving beyond that subgoal.

0 The student recopies the information given in the problem.

Notes: radian measure for part (a) is $\frac{\pi}{6}$ and $\frac{5\pi}{6}$
degree measure for part (a) is 30° and 150°
radian measure, in decimal form, is approximately 0.52 and 2.62
the solutions to $2\sin^2(2\theta) \pm 5\sin(2\theta) + 2 = 0,\ 0 \le \theta < 2\pi$, are $\left(\frac{\pi}{12}, \frac{5\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12}\right)$
The student demonstrating acceptable achievement can solve first-degree trigonometric equations on the domain $0 \le \theta < 2\pi$ and $0° \le \theta < 360°$.

Question 2

Diagram

2 The student draws and labels a diagram that correctly models such a "telephone fan-out system."
1 The student draws a diagram that models a "telephone fan-out system" (the next level meaning more people contacted) but does not clearly communicate an understanding of this problem.
0 No diagram is provided.

Equation

3 The student's equation reflects the model (or a more general model) of such a "telephone fan-out system" and represents the total number of people phoned, with the variables clearly defined.
2 The student's equation reflects the model (or a more general model) of such a "telephone fan-out system" and represents the total number of people phoned; however, the variables are not clearly defined.
1 The student attempts to write an equation that represents the total number of people phoned; however, the variables are not clearly defined nor is the equation a reflection of their model.
or
The student's equation accurately reflects some part of the model and there is an attempt to define the variables; however, the equation does not represent the total number of people phoned.
0 The student writes an equation that is not related to the problem.

Assumption and Factors

2 The student correctly identifies more than two assumption/factors to be considered in designing the "telephone fan-out system."
1 The student correctly identifies one or two assumption/factors to be considered in designing the "telephone fan-out system."
0 No assumption or factor is identified or the assumption and factors identified are not relevant to the problems.

National Library of Canada
Bibliothèque nationale du Canada
3 3286 50442 6418

Question 3

The student chooses

5 The student clearly communicates a **complete** and **correct** description of how both models represents the problem (acknowledge all of the elements and may contain a minor flaw).

4 The student clearly communicates a **correct** description of how both models represents the problem, but the explanation contains a minor flaw that does not reflect a misunderstanding of the problem.

3 The student clearly communicates a **complete** and **correct** description of how one of the models represents the problem.

or

The student clearly communicates a **correct** description that may contain a minor flaw of how one of the models represents the problem **and** begins a **correct** explanation that goes beyond simply copying the data given in the problem of how the other model represents the problem.

2 The student clearly communicates a **correct** description of one of the models but the explanation contains a minor flaw, which does not reflect a misunderstanding of the problem.

or

The student begins a **correct** description of both models. The description goes beyond simply copying the data given in the problem.

1 The student begins a **correct** description of how one of the models represents the problem. The description goes beyond simply copying the data given in the problem.

0 The student simply copies the data given in the problem or the student's response is not correct or is not related to the given problem.

Question 4

5 The student determines the **exact values** of x to be $x = \dfrac{-1 \pm \sqrt{17}}{4}$ and $x = 3$.

4 The student correctly identifies $x = 3$ as one of the solutions **but** makes an error that results in two incorrect exact values

or

determines approximate decimal values for x at least to the nearest tenth.

or

The student identifies the 2 exact values but does not explicitly state that $x = 3$ is one of the solutions.

3 The student correctly identifies the factors of $2x^3 - 5x^2 - 5x + 6$ as $(x - 3)$ and $(2x^2 + x - 2)$.

or

The procedure for solving the equation is complete and correct.

or

The strategy selected by the student could not lead to exact values, however does lead to decimal approximations, correct to the nearest tenth, for the values of x.

2 The student begins a strategy that could have led to the exact or approximate values for x and successfully reaches a subgoal.

or

The student gives the correct exact values for x with no supporting work.

1 The student goes beyond copying data from the problem; for example, the student shows $2x^3 + 6 = 5x^2 + 5x$ or an equivalent form.

or

The student identifies $x = 3$, in some way, as a point where $M(x) = N(x)$ but does not continue in solving the problem.

or

Identifies the correct decimal approximations with no supporting work.

0 The student only copies the data from the problem.

For further information, contact Florence Glanfield or Lowell Hackman at the Student Evaluation Branch, 403-427-0010.